Kelsey Kempner

Senior Project Thesis

15 April 2019

Project Narrative: Dance as a Physical Training for Autism and Other Developmental Disorders

With IRB approval, I researched the effects of dance as a physical training for the motor abilities of children with developmental disorders. I taught weekly creative dance class to preschoolers at the Nisonger Center Early Childhood Education Program, with a focus on increasing body awareness and motor coordination. My class consisted of a diverse set of students with varying abilities, all engaged in a preschool/day-care environment. In addition to the research section of this project, I created a solo to celebrate the joy of movement my young students brought to dance.

As an undergraduate at The Ohio State University, I studied the majors of both dance and neuroscience. These gave me expertise in a variety of forms including but not limited to, abnormal psychology, motor systems, dance pedagogy, behavioral neuroscience, dance improvisation, and current research in neuroscience.

This project highlighted my work and desires of bringing dance and neuroscience together. I saw this project as only the beginning of a career engaging the possibilities of dance in neuroscience. This project was significant in that it allowed me to explore an actual, feasible link between my two passions, proving that a career in dance and science is not only possible, but of great importance to the fields of art and science. Dance therapists and teachers are already working with students, using dance as a means to increase brain activity. However, these

practices are rarely written about in the academic realm and almost non-existent from science journals. With my background, I plan and planned to fill this need for writing on these great innovations.

I embarked on this specific project after shadowing pediatric occupational therapists for an independent study on movement therapy. While with the therapists, I learned that children with autism and developmental disorders suffer from motor impairments which come from deficits in proprioception and motor planning. I knew about the social and cognitive symptoms related to developmental disorders but did not realize the gravity that these motor impairments have on quality of life. As a lifelong dancer, I know that dance training inherently promotes body awareness and motor planning through a need to be aware of your space, ability to move different parts of your body in different ways, execution of complex movements, ability to change level, time, and quality around your movement, and ability to change movement quickly. Thus, I hypothesized that a dance class for children with developmental disorders may have the capacity to increase motor efficiency for these children.

Throughout this project , I gained diverse knowledge, especially in the areas of research, teaching, and administrative negotiation. To embark on this project, I independently learned how to navigate CITI training, proposal writing, grant writing, and Institutional Review Board writing and editing. Through these processes, I learned about communication, problem-solving, the slow speed of research, and patience. Although I have taught dance in multiple settings, this project was different in that it, took place within a preschool, included multiple children with developmental disorders, and included children that were not thrilled by the idea of taking dance class. Because of these new experiences, I broadened my dance pedagogy knowledge and learned new classroom management dance education skills. For one, I learned that you cannot

ask children if they want to do something; you tell them to do the activity. This linguistic change made all the difference in my students' willingness to participate. I also learned that I need to give different directions to different children in order for them to correctly understand the activity. For example, one of my children with a developmental disorder often did not engage well with verbal cues. For this reason, I used American Sign Language signs to tell him whether he should be sitting or standing (He used these signs on a daily basis in the regular classroom). In the same way, I learned a lot about the children's individual creativities beyond what you may expect. For example, my one student with down syndrome created the most interesting and meticulous gesture phrases based on associating Disney songs to the part of the movie in which they appeared. Another child created well developed stories for the movements we did and would tell me about them in great detail. Another student, who was mostly non-verbal, began saying "dancing face" every time he saw me, referring to the first song of our dance classes. Upon hearing the song, he would sit directly in front of me and match his faces with mine. Through teaching, I also learned to come prepared with multiple options for activities. Many times, my planned lessons were derailed by distraction or lack of interest. I needed to be flexible and change the activity in order to keep my students participating. Lastly, I gained the most unexpected skillset of management. For this project, I had to communicate with many different parties: teachers, student aids, volunteers, parents, directors, secretaries, and medical center staff. I learned to ask for help from these people when I needed it and negotiate these people's needs without corrupting the integrity of the project.

As part of my project, I also created a solo based on my experience teaching my preschool students. The solo, *Play!*, performed at the Senior Dance Concert evolved from the pure joy my children experienced in movement. The work documented the fun adventure of

dancing with no agenda and strived for the removal of ideas of "high art" and validation, an experience easily accessed by my preschool students. To create the movement for the dance I pulled from a variety of places. Most importantly, I included gestures and movements my students did within class. I also created scores from my own favorite places to move in during my own childhood, including movements at the playground, the beach, and the backyard with my brother. Lastly, I visited and danced on playgrounds to create another score. I combined these aspects with the humorous way my children act in dance class to create a 4-minute work comprised of taking up lots of space, comedy, and free movement. There are various movements in the piece that are directly pulled from some of my students' favorite movements.

Overall, through this project, I learned that I am capable of leading and conducting my own research. I also learned that I enjoy teaching young children, especially young children with disabilities. My students taught me how to be silly, how to be patient, and how to fall in love with them in a very short amount of time.

It also should be noted that this project would not have come into fruition without the gracious help of my research assistant Dominique Ebba who recorded observation on the participation of the students within the study, Lise Worthen-Chaudhari who guided me through IRB protocol and data analysis, and my advisers Dr. Melanye White Dixon, Dr. Nyama-McCarthy Brown, and Dr. Gary Wenk.

Dance as a Physical Training for Autism and Other Developmental Disorders

Kelsey Kempner, BFA Ohio State University Dance Department, BS Ohio State University Neuroscience Program

Advisers: Dr. Melanye White Dixon, Dr. Gary Wenk, Dr. Nyama McCarthy-Brown

Expert Resource: Lise Worthen-Chaudhari

1. Introduction

Autism is a neurodevelopmental disorder with core features that include atypical social interaction and a pattern of repetitive and restrictive behaviors (CDC 2018). Children with autism have also been shown to have poorer motor abilities than their normally developing peers in the areas of gait, coordination, and balance (Bhat, Landa, and Galloway 2011). Developmental disorders are defined by the CDC as a large group of conditions that arise during development in which there is impairment in "physical, learning, language, or behavior areas" (CDC 2017). Approximately 1 in six children has a developmental disorder (CDC 2017). These include conditions such as autism spectrum disorder, down syndrome, ADHD, cerebral palsy, and intellectual disabilities.

Evidence is accumulating that dance represents an engaging physical activity option for individuals with neural deficits that improves participation (Worthen-Chaudhari et al. 2015), balance (Worthen-Chaudhari 2013) (Hackney & Earhart, 2009), and motor consistency

(Chaudhari et al., 2017) (Hackney & Earhart, 2009). Through dance-based practices that integrate full-bodied movement, tactile stimulation, and practice of different qualities of movement, I postulated that dance practice inherently promotes "body awareness" (coordination/balance), an outcome of interest previously studied among children with developmental disorders (Molloy et al. 2003). These motor impairments in developmental disorders are suggested to be due to abnormal proprioception (Weimer, Schatz, Lincoln, Ballantyne, & Trauner, 2001).

As a lifelong dancer and student of both dance and neuroscience, I brought my knowledge of contemporary dance and creative movement to form a dance class that could increase motor skills in my students. The purpose of this research was not to create a novel form of a dance education class, but to instead evaluate the effects of pre-existing dance pedagogy methods on the physical training of children with developmental disorders.

My concerns with this physical training centered around whether children with and without developmental disorders will attend and participate in the classes. To address this concern, I conducted a Phase I feasibility trial in which I and research assistant Dominique Ebba documented the attendance and participation among subjects. I focused on motor control/biomechanics/body awareness (coordination/balance) as our initial outcome target because this aspect of health has been shown to affect quality of life and safety (Dunn 2013).

The objective of this study was to evaluate the feasibility of dance classes as a physical training for children with autism and other developmental disorders in terms of their attendance and participation in session activities of dance class and to explore participants' body awareness before and after intervention as measured using the validated Pediatric Balance Scale.

2. Method

2.1 Classes: The study consisted of 7 weekly dance classes conducted in the classrooms at the OSU Medical Center Nisonger Early Childhood Education Program. The classes were 30 minutes long, and students were divided between two already established preschool classrooms. These classes had an approximate ratio of 1/3rd of the class containing children with IEPs (individualized education program) or developmental disabilities and 2/3^{rds} considered neurotypical. In this case, our neurotypical children are children who have currently received no diagnosis of a developmental disorder and who do not have an IEP. Each class contained approximately 15 students each. All children in the class had the option of taking class, but only those with consent from parents were observed in this study. The dance classes were taught by the principle researcher, Kelsey Kempner. Lessons were derived from contemporary dance technique, dance pedagogy, and creative movement. Classes were constructed using creative movement techniques derived from dance educator, Anne Green Gilbert, the creative movement themes I experienced in my own training from my instructor, Heather Wayne, and contemporary dance techniques acquired through The Ohio State University Department of Dance (Gilbert 2015). The classes involved various facets of contemporary dance including improvisation, locomotion skills, weight shifts, stretching, and exploration of the elements of creative dance, including space, time, and energy. The basic lesson plan outline is shown below.

Table 1. **Sample Lesson Plan**

Activity	Description	Skills

Welcome/ Warm-Up	• "Dancing Face" song, follow along • Cardio warm-up: shaking, wiggling, jumping, swaying, etc.	• Work on relationships and affect • Increase heart rate, get body aware and ready for movement
Stretch	• Stretching different body parts in progression, stretch up to ceiling and down to floor, warm up neck and shoulders, flex and point feet, stretch over legs, etc. • Isolating movement in different body parts	• Bringing awareness to different parts of body • Learning to move only one part of body at a time • Learning difference between moving whole body and parts of body • Ensuring body is warm and ready for dancing
Exploration	• Practice different locomotion activities with different elements (ex: slow tiptoes, low marching) • Practice dancing to tempo of the song	• Learn to control and modify one's own movement • Shift movement tempo • Practice weight shifts • Practice locomotion activities • Learn how to move at different levels
Concluding Activity	• Each child gets a chance to dance individually • Each child leaps over object on the floor • Everyone else cheers for student	• Children practice moving independently • Learn how to plan and design own movement • Practice weight shifts • Practice safe jumping

2.2 Participants. The study consisted of 12 preschool students, ages 3 to 5 years old. 8 participants were considered neurotypical (NT). Four participants were diagnosed with developmental disorders (DD): one with autism spectrum disorder, two with unspecified developmental disorders, and one with down syndrome. The neurotypical students were considered neurotypical on the basis that they did not have a developmental disorder diagnosis.

2.3. Attendance. Participant attendance at the 7 classes offered was recorded for each child.

2.4 Participation. Participation was recorded by the research assistant as the ratio of engagement in the activity in session activity/total session time. Engagement was defined as participating in the dance activity occurring at the given time. Perceived reasons for lack of participation were also noted.

2.5 *Pediatric Balance Scale.* Balance was utilized as a measure of body awareness, as measured through balance the Pediatric Balance Scale (PBS). The scale has been validated for use with children to test for measures of balance in children with motor impairments (Franjoine 2003). The test is a modified version of the Berg Balance Scale and measures the balance and weight shifts of the child in a variety of positions, scoring the child 0-4 on their ability to succeed in the balance task (Franjoine 2003). Participants are scored out of a possible 56 points. I measured all subjects on the PBS at baseline and the subjects with developmental disorders after 7 weeks of dance classes. Baseline scores were compared between the two groups. Pre-post intervention scores were compared for participants with developmental disorders.

2.6 Data Analysis. For attendance, per previously published criteria for assessing feasibility (Worthen-Chaudhari et al. 2017), the criteria for success was set as a majority of participants with DD attending at least 50% of classes offered.

For outcomes of participation and balance, non-parametric descriptive statistics were calculated in Microsoft Excel (median (IQR)). Primary outcome: Median participation for participants who were NT and DD is plotted. Secondary outcome: Due to the small sample of participants with developmental disorders (n=4), t-tests were performed in Microsoft Excel to assess groupwise differences in balance between the NT and DD group at baseline (2-tailed, unequal variance) as well as pre-post difference in balance for participants with DD (2-tailed, paired).

1. Results

3.1 Attendance: Feasibility criteria were met: median attendance for the subjects was found to be 100% (100-100%) for participants who were neurotypical and 93% (79-100%) for children with developmental disorders.

3.2 Participation and Balance: Median participation rate per class was 80% (71-82%) for the NT group and 33% (28-45%) for DD group (Figure 2). Starting balance scores from the Pediatric Balance Scale were lower (p=0.021) for participants with developmental disorders (42 (39-45)) compared to those without (51 (50-52)). Among participants with DD, there was improvement in balance (p=0.028) post-intervention when all 4 participants with DD returned for testing and demonstrated post-intervention balance scores of 50 (50-51).

Baseline Pediatric Balance Scale Scores

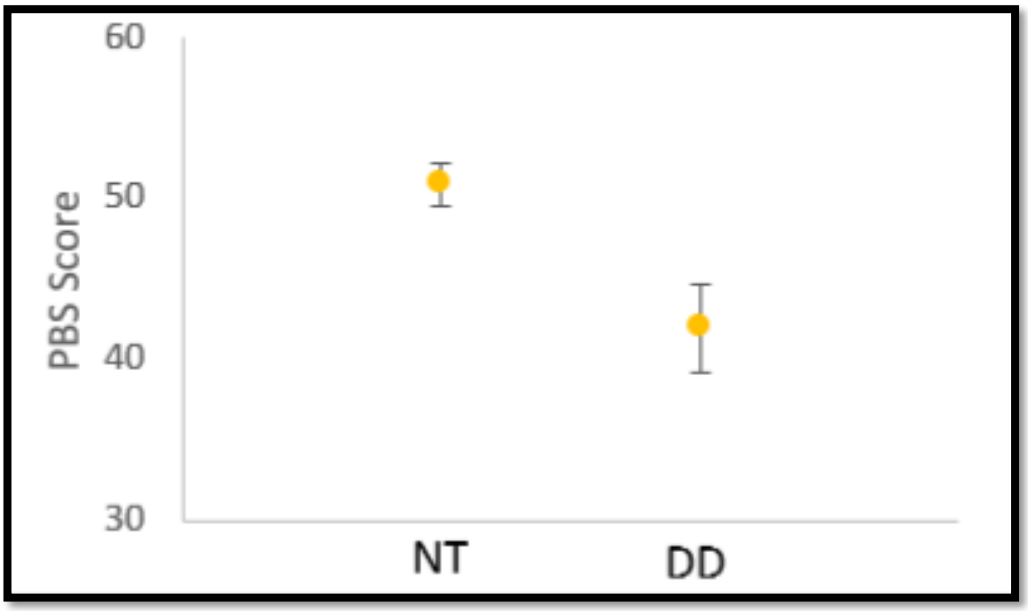

Figure 1. **Baseline PBS Score** Balance scores from baseline Pediatric Balance Scale comparing neurotypical subjects to subjects with developmental disorders

Median Participation Percentages

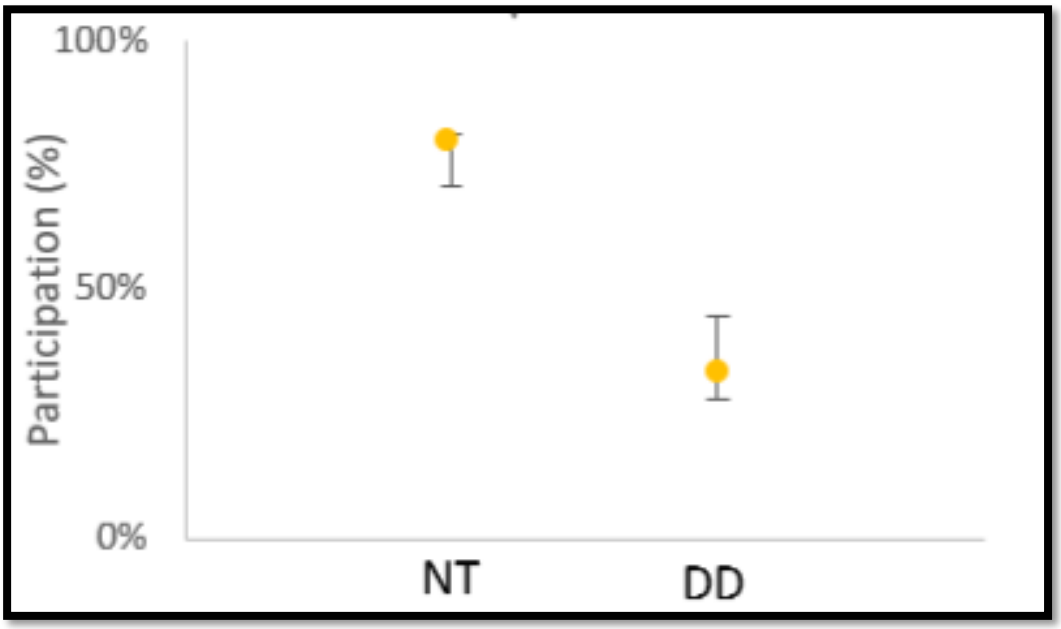

Figure 2. Percent time subjects spent participating in the dance class, between neurotypical subjects and subjects with developmental disorders.

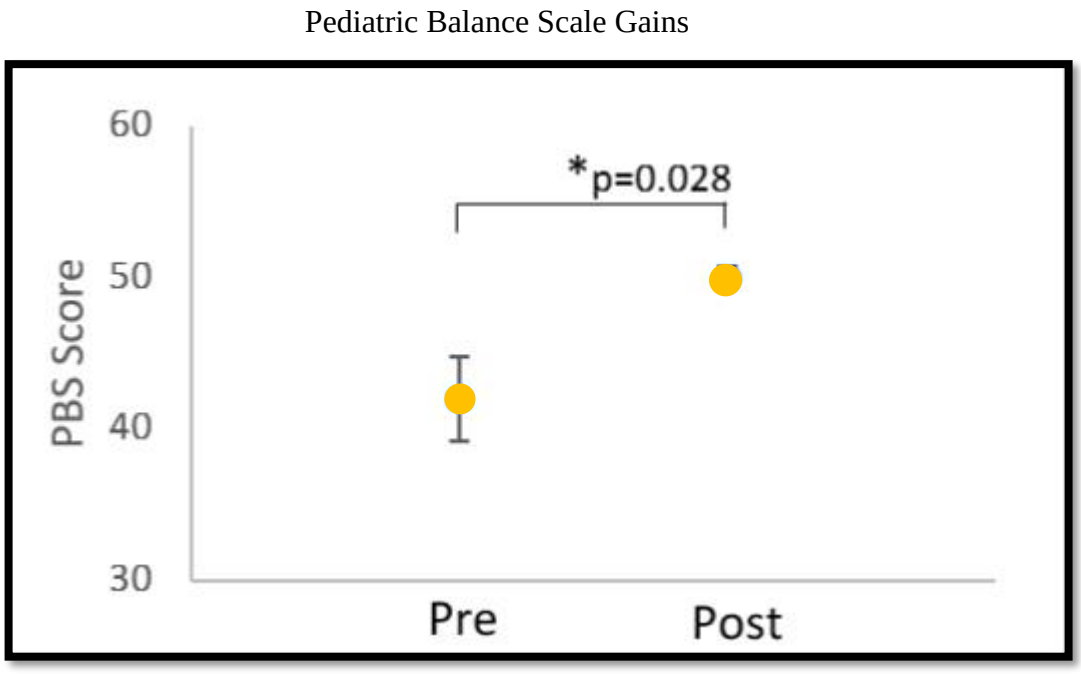

Figure 3. Baseline Scores from Pediatric Baseline Score compared to post-test scores.

4. Discussion

This is the first known study of dance as a physical training for children with autism and other developmental disorders and indicates that the form of creative dance studied here is a feasible activity for young children (≤ 5 years of age) with and without developmental disorders to engage in. Results show that gains in balance were demonstrated among children with developmental disorders following dance training (p=0.028), with 33% (28-45%) participation in the classes, suggesting that creative dance activity is a salient form of engaging children with DD to promote body awareness.

As this was a feasibility study, some limitations arose. The sample size was limited to 8 neurotypical children and 4 children with developmental disorders. A larger group of subjects would be necessary to fully determine the effect of dance practice. The study was also limited by

the environment as the children took the class in the regular classroom space, with distractions coming from parents, teachers, toys, etc. Some distractions noted included, but were not limited to: parent entering the room, distracted by looking at a book, distracted by other child, teacher requesting them, bathroom urgencies, and other children crying. Future studies or implementations of this physical training should be conducted in a more controlled room with less access to distractions. However, the ability of this study to be successful in a distracted space is important to note as no preschool classroom will ever have complete control of distractions. Another limitation of the study was the measure of the Pediatric Balance Scale. While balance is an accurate measure of body awareness, other body awareness measurements should be implemented to validate that body awareness was in fact being improved. It is important to note the effects of the inclusion of both children with and without developmental disorders in the same class. Future studies could evaluate the effect of influence of neurotypical controls of the effectiveness of the training. It should also be noted that as with all human research studies, children may have become more accustomed to the researcher through time. Future directions of this study could explore different genres of dance, different measures of body awareness, older or younger students, parental participation in classes, and a ratio change of one teacher to one student.

Overall, this pilot study suggests that dance as a physical training may improve body awareness in terms of balance in children with developmental disorders.

*This project was funded by the Arts Undergraduate Research Scholarship at Ohio State University. Thank you for your support.

References

Autism Spectrum Disorder (ASD). (2018). Retrieved from https://www.cdc.gov/ncbddd/autism/facts.html

Bhat, A. N., Landa, R. J.; Galloway, J. C. (2011). Current Perspectives on Motor Functioning in Infants, Children, and Adults With Autism Spectrum Disorders. Physical Therapy, 91(7), 1116-1129. doi:10.2522/ptj.20100294

Developmental Disabilities. (2017). Retrieved from https://www.cdc.gov/ncbddd/developmentaldisabilities/index.html

Dunn, W., Griffith, J. W., Morrison, M. T., Tanquary, J., Sabata, D., Victorson, D., Gershon, R. C.(2013). Somatosensation assessment using the NIH Toolbox. Neurology, 80(Issue 11, Supplement 3). doi:10.1212/wnl.0b013e3182872c54

Gilbert, Anne Green. *Creative Dance for All Ages: a Conceptual Approach*. Human Kinetics, 2015.

Franjoine, M. R., Gunther, J. S., & Taylor, M. J. (2003). Pediatric Balance Scale: A Modified Version of the Berg Balance Scale for the School-Age Child with Mild to Moderate Motor Impairment. Pediatric Physical Therapy, 15(2), 114-128.doi:10.1097/01.pep.0000068117.48023.18

Hackney, M. E., Earhart, G. M. (2009). Effects of dance on balance and gait in severe Parkinson disease: A case study. Disability and Rehabilitation,32(8), 679-684. doi:10.3109/09638280903247905

Molloy, C. A., Dietrich, K. N., & Bhattacharya, A. (2003). Postural Stability in Children with Autism Spectrum Disorder. Journal of Autism and Developmental Disorders, 33(6), 643-652.doi:10.1023/b:jadd.0000006001.00667.4c

Weimer, AK., Schatz, AM., Lincoln, A., Ballantyne, AO., Trauner, DA. (2001). “Motor” impairment in Asperger syndrome: evidence for a deficit in proprioception. *Journal of Developmental & Behavioral Pediatrics*, vol. 22, no. 2, 2001, pp. 92–101., doi:10.1097/00004703-200104000-00002.

Worthen-Chaudhari, L., Schmiedeler, J. P., Basso, D. M. (2015). Training conditions that best reproduce the joint powers of unsupported walking. Gait & Posture, 41(2), 597-602.doi:10.1016/j.gaitpost.2015.01.003

Worthen-Chaudhari, L., Mcgonigal, J., Logan, K., Bockbrader, M. A., Yeates, K. O., & Mysiw, W. J.(2017). Reducing concussion symptoms among teenage youth: Evaluation of a mobile health app. Brain Injury,31(10), 1279-1286. doi:10.1080/02699052.2017.1332388

Worthen-Chaudhari L, Whalen C, Swendal C, Bockbrader MA, Haserodt S, Smith R, Bruce MK, Mysiw W (2013) A feasibility study using interactive graphic art feedback to augment acute neurorehabilitation therapy. NeuroRehabilitation 33.3, 481-490. CV 2014